Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						4	4	2	0	/	2	H	Signature	

Paper Reference(s)

4420/2H

Examiner's use only

Team Leader's use only

London Examinations IGCSE

Physics

Paper 2H

Higher Tier

Tuesday 4 November 2008 – Morning

Time: 2 hours

Materials required for examination
Nil

Items included with question papers
Nil

Question Number	Leave Blank
1	
2	
3	
4	
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11	
12	
13	
14	
15	
Total	

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initial(s) and signature.
The paper reference is shown at the top of this page. Check that you have the correct question paper.
Answer **ALL** the questions. Write your answers in the spaces provided in this question paper.
Show all the steps in any calculations and state the units.
Calculators may be used.

Information for Candidates

The total mark for this paper is 120. The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**. There are 15 questions in this question paper.
Any blank pages are indicated.
Useful formulae are given on page 2.

Advice to Candidates

Write your answers neatly and in good English.

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FORMULAE

You may find the following formulae useful.

energy transferred = current × voltage × time $\qquad E = I \times V \times t$

pressure × volume = constant $\qquad p_1 \times V_1 = p_2 \times V_2$

$$\frac{\text{pressure}}{\text{kelvin temperature}} = \text{constant} \qquad \frac{p_1}{T_1} = \frac{p_2}{T_2}$$

$$\text{frequency} = \frac{1}{\text{time period}} \qquad f = \frac{1}{T}$$

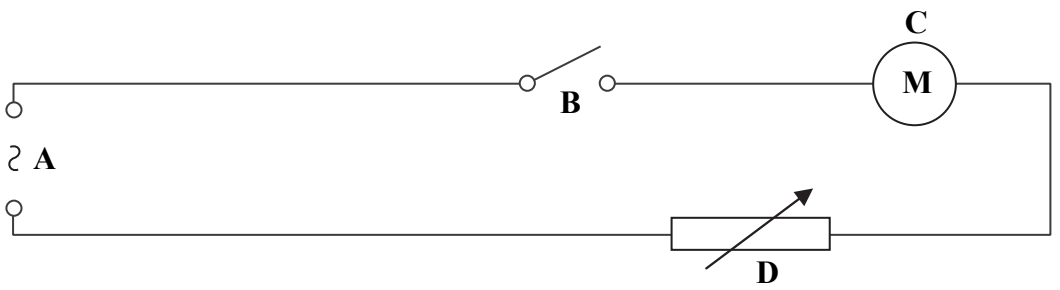
$$\text{power} = \frac{\text{work done}}{\text{time taken}} \qquad P = \frac{W}{t}$$

$$\text{power} = \frac{\text{energy transferred}}{\text{time taken}} \qquad P = \frac{W}{t}$$

Where necessary, assume the acceleration of free fall, $g = 10\ \text{m/s}^2$.

Leave blank

1. The diagram shows an electric circuit.



(a) What do the symbols, **A**, **B**, **C** and **D**, represent?

A .....

(1)

B .....

(1)

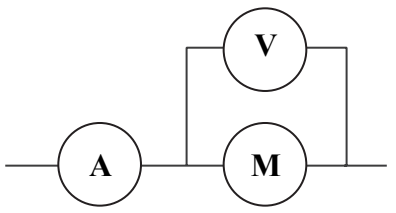
C .....

(1)

D .....

(1)

(b) A student connects two meters to **M** as shown.



Complete the table to name each meter and what it measures.

Meter	Name	What it measures
V	.....	This meter measures the ..... across **M**.
A	.....	This meter measures the ..... in **M**.

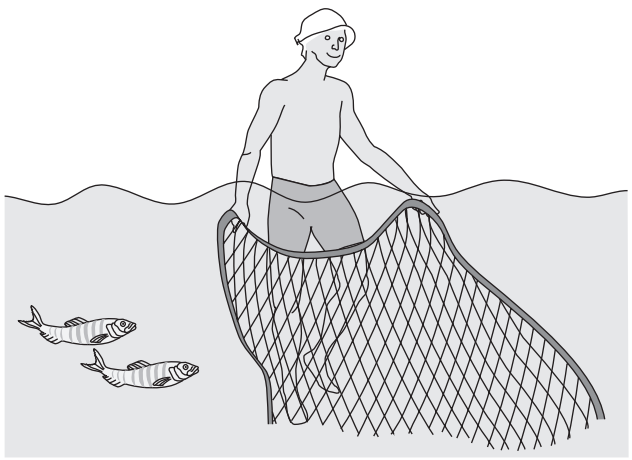
(2)

Q1

(Total 6 marks)

Leave blank

2. The diagram shows a fisherman standing in water.



(a) In 8 seconds, 4 complete waves pass the fisherman.

Calculate the frequency of the waves and give the unit.

.....

Frequency =.....

(2)

(b) These water waves are transverse waves.

Name **one** other example of a transverse wave.

.....

(1)

(c) Complete the sentence.

Waves can transfer energy and ..... without transferring matter.

(1)

(d) What is meant by the time period of a wave?

.....

.....

.....

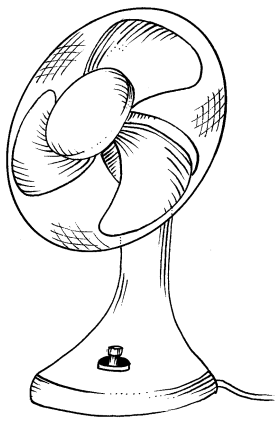
(2)

Q2

(Total 6 marks)

Leave blank

3. The diagram shows an electric fan.



(a) Complete the sentences.

The useful energy output of the fan is ..... energy.

Energy is wasted as ..... energy and as

..... energy.

(2)

(b) State the equation for efficiency.

Efficiency =

(1)

(c) The useful power output of the fan is 50 watts.

Use the equation

power × time taken = work done

to calculate the useful work done by the fan in 15 minutes and give the unit.

.....

.....

Useful work = ...

(3)

Q3

(Total 6 marks)

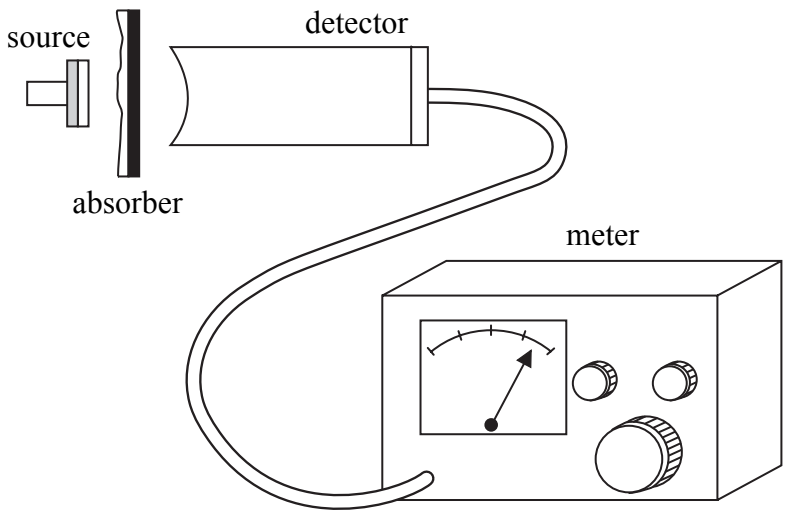
Leave blank

4. (a) Name **one** source of background radiation.

.....

(1)

(b) The diagram shows a Geiger-Muller detector connected to a count rate meter.
The count rate from a radioactive source is measured with different absorbers present.



The table shows the results.

Absorber	**Average count rate (counts per second) [after allowing for background radiation]**
no absorber [apart from 10 mm of air]	41
card 1 mm thick	24
metal 3 mm thick	0

Leave blank

Explain how the results show that the source

(i) emits alpha (α) radiation,

.....

.....

(1)

(ii) emits beta (β) radiation,

.....

.....

(1)

(iii) does **not** emit gamma (γ) radiation.

.....

.....

(1)

(c) A source has a half-life of 15 minutes. When the activity of the source is measured it is 400 megabecquerels (MBq).

Estimate the activity in MBq of the source after one hour.
Show your working.

.....

.....

Activity = ... MBq

(2)

Q4

(Total 6 marks)

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5. (a) Explain why it may be dangerous to switch on a light when your hands are wet.

.....

.....

.....

(2)

(b) Many electrical appliances have a metal casing.

A live wire comes into contact with the metal casing.
Explain how an earth wire and a fuse prevent the user receiving an electric shock.

Earth wire .....

.....

Fuse .....

.....

(2)

(c) The resistance of a person's body is 10 000 ohms.
A current of 0.020 amps will give the person a serious electric shock.

Use the equation

voltage = current × resistance

to calculate the minimum voltage in volts which will cause this.

.....

.....

Minimum voltage = ... V

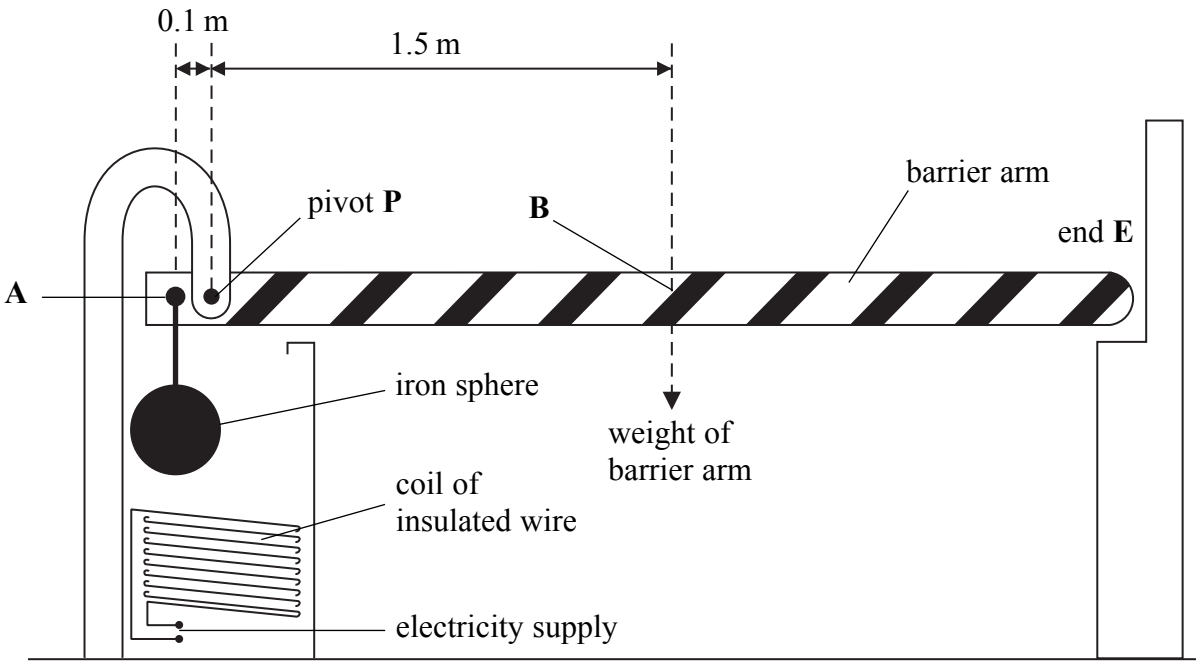
(2)

Q5

(Total 6 marks)

Leave blank

6. The diagram shows a barrier at a car park. The barrier arm is usually in the position shown. An iron sphere is attached to the barrier arm at **A**. The weight of the barrier arm acts at **B**. When there is a current in the coil the barrier arm pivots at **P** and end **E** moves upwards.



(a) At which point, **A**, **B**, **E** or **P**, is the centre of gravity of the barrier arm?

Point .....

(1)

(b) Complete the sentence.

The coil acts as an .....

(1)

(c) Why is the coil made of **insulated** wire?

.....

.....

(1)

(d) What is the cause of the force on the barrier arm at **A** before the electricity is switched on?

.....

(1)

Leave blank

(e) When the electricity is switched on the total force which acts at **A** is 900 newtons. This force can just start to pull the iron sphere down.

Use the distances shown on the diagram to calculate the weight in newtons of the barrier arm.

Show your working.

.....

.....

.....

Weight of barrier arm = ... N

(3)

Q6

(Total 7 marks)

Leave blank

7. (a) Use the relationship between area, force and pressure to explain why it is easier to cut with a sharp knife than a blunt knife.

.....

.....

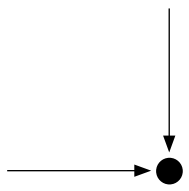
.....

.....

(2)

(b) The diagram shows a point in a gas. Two arrows representing some of the pressure at the point are shown.

(i) Add two more arrows to the diagram to show how pressure acts at the point.



(2)

(ii) What assumption did you make?

.....

.....

(1)

(c) The density of some sea water is 1025 kg/m^3.

Calculate the increase in pressure in pascals from the surface of the sea to the bottom when the sea water is 25 metres deep.

Show your working.

.....

.....

Pressure = ... Pa

(3)

Q7

(Total 8 marks)

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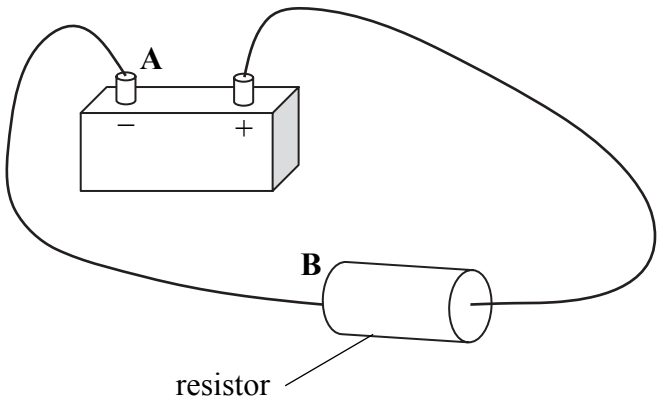
8. (a) A student connects a 12 V battery to a resistor as shown.



(i) Draw an arrow in the resistor to show the direction of electron flow.

(1)

(ii) Explain your answer.

.....

.....

(2)

(b) The potential difference across the wire **AB** is 0.20 V when the current in the circuit is 3.0 A.

The student leaves the circuit connected for 4 minutes.

(i) How much energy in joules is transferred from the battery to the wire **AB** in this time?

.....

.....

Energy transferred = ... J

(2)

(ii) Into what form is this energy transformed?

.....

(1)

Leave blank

(c) The 12 V battery is now replaced by a 6 V battery.

(i) How much energy in joules is transferred from the 6 V battery to the wire **AB** in 4 minutes?

.....

.....

Energy transferred = ... J

(2)

(ii) Explain your answer.

.....

.....

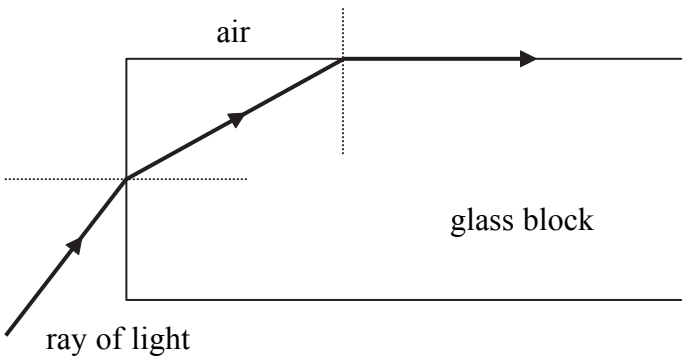
(1)

Q8

(Total 9 marks)

Leave blank

9. (a) A student shines a ray of light at a glass block as shown below. The refractive index of the glass is 1.6.



Show on the diagram for this ray of light

(i) the angle of incidence from air to glass and label it **I**,

(1)

(ii) the angle of refraction inside the glass and label it **R**,

(1)

(iii) the critical angle and label it **C**.

(1)

(b) (i) What does the term **critical angle** mean?

.....

.....

(1)

(ii) State the relationship between critical angle and refractive index.

.....

(1)

(iii) Calculate the critical angle in degrees for this block of glass.

.....

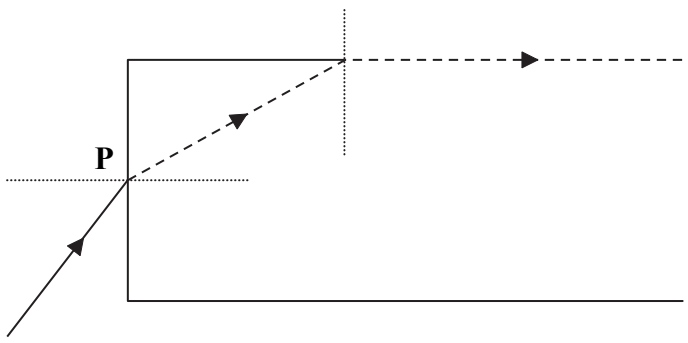
.....

Critical angle = ... °

(1)

Leave blank

(c) The diagram below shows the ray of light entering the glass block at point **P**. The dashed path is for glass of refractive index 1.6.



(i) Draw the path of the ray from **P** if the refractive index of the glass is greater than 1.6.

(2)

(ii) Explain the path that you have drawn.

.....

.....

.....

.....

.....

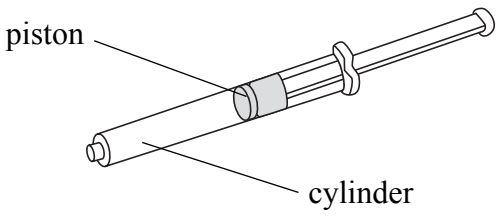
(2)

Q9

(Total 10 marks)

Leave blank

10. The diagram shows a syringe. The volume of the air in the cylinder is 150 cm^3 at a pressure of 100 kPa.



A student places a finger over the open end of the syringe and then pushes the piston down. He reduces the volume of the air in the syringe by 30 cm^3.

(a) Calculate the new pressure in kilopascals of the air in the syringe.

.....

.....

Pressure = ... kPa

(2)

(b) One assumption that is made in this calculation is that the temperature of the air does not change. State **one** other assumption.

.....

(1)

(c) If some of the energy used in moving the piston is transferred to heat energy, the pressure of the gas would not be the same as that calculated in (a).

(i) Would it be bigger or smaller?

.....

(1)

(ii) Explain your answer.

.....

.....

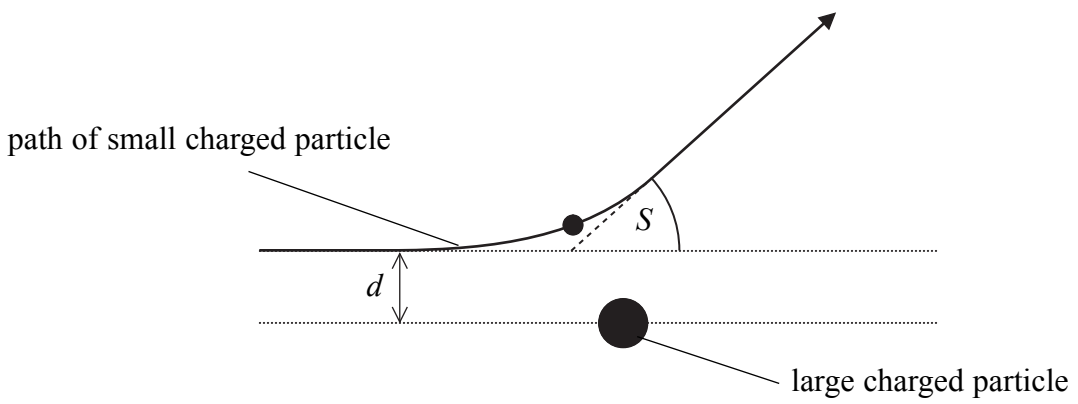
(2)

Q10

(Total 6 marks)

Leave blank

11. The diagram shows the path of a small charged particle being deflected as it passes a large charged particle. The angle of deflection *S* depends on the distance *d*.



(a) Geiger and Marsden's experiment, from which the structure of the atom was determined, involved a small particle being deflected by a large particle.

(i) Name the small particle.

.....

(1)

(ii) Name the large particle.

.....

.....

(1)

(b) (i) What can you conclude about the type of charge on the two particles?

.....

.....

(1)

(ii) Explain your conclusion.

.....

.....

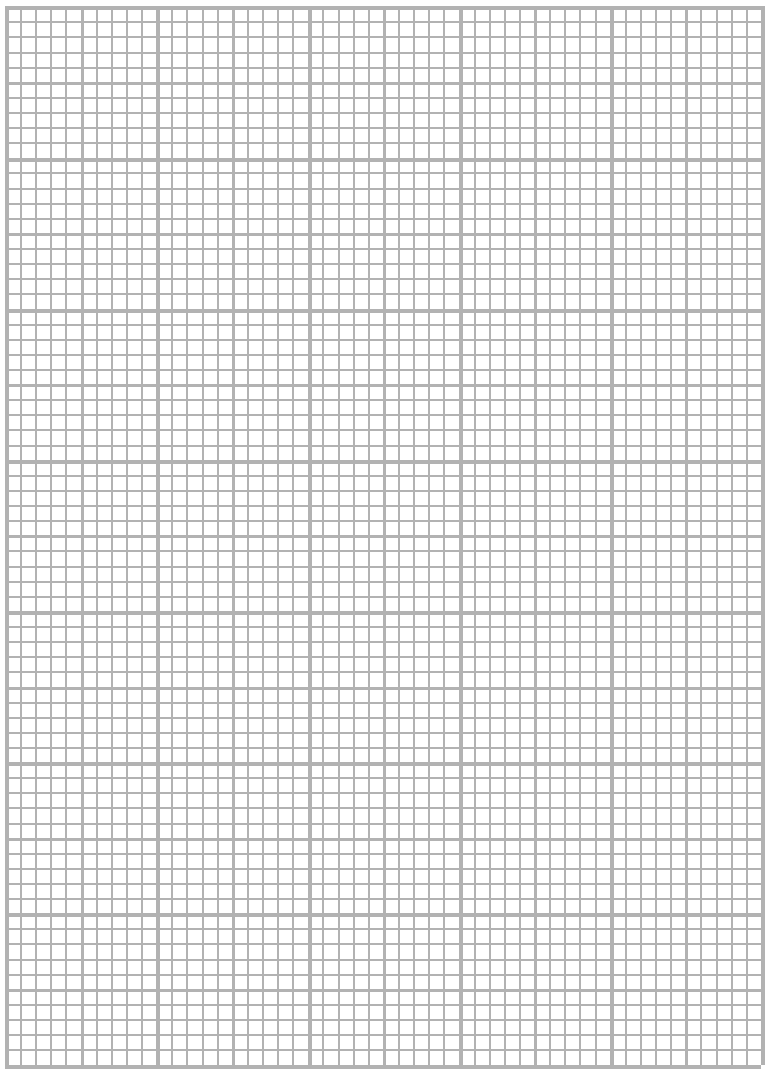
(1)

Leave blank

(c) The table shows some results for Geiger and Marsden's experiment.
The distances are very small and measured in femtometres (fm).

Distance d (fm)	27	32	39	51	72	100
Angle of deflection S (°)	70	60	50	40	30	22

(i) Plot a graph of angle of deflection (y-axis) against distance (x-axis). Draw a smooth curve through your points.



(5)

(ii) Use your graph to find the angle of deflection in degrees for a distance of 60 fm.

Angle = ... °

(1)

Leave blank

(d) Use values and ranges from the box to complete the sentences.

0°	**0° to 45°**	**45° to 90°**	**90°**	**above 90°**

In Geiger and Marsden's experiment, when the distance, *d*, was very much larger than the radius of the large particle, the angle of deflection was .....

When the distance, *d*, was very much less than the radius of the large particle the angle of deflection was .....

(2)

(e) (i) State the property of the smaller particle, apart from its charge, that must be kept constant.

.....

(1)

(ii) Why did Geiger and Marsden's experiment take place in a vacuum?

.....

.....

(1)

(f) State the name of the model of the atom proposed by Rutherford as a result of this experiment.

.....

(1)

Q11

(Total 15 marks)

Leave blank

12. Elements with a higher atomic number than uranium can be formed artificially.
The table shows details of some of these elements.

Element	Symbol	Atomic number
neptunium	Np	93
plutonium	Pu	94
americium	Am	95
curium	Cm	96

(a) It is possible to form a nucleus of plutonium by bombarding a nucleus of uranium with an alpha particle.

(i) Complete the nuclear equation for this reaction

$$^{238}_{92}\mathrm{U} \quad + \quad ^{4}_{2}\alpha \quad \rightarrow \quad ^{241}_{94}\mathrm{Pu} \quad + \quad \begin{matrix}\cdots\cdots\cdots\\ \cdots\cdots\cdots\end{matrix}\mathrm{X}$$

(2)

(ii) Identify particle X.

.....

(1)

(b) Plutonium-241 formed in the reaction above then undergoes beta decay.

(i) Complete the nuclear equation for the beta decay of plutonium-241.

$$^{241}_{94}\mathrm{Pu} \longrightarrow \begin{matrix}\cdots\cdots\cdots\\ \cdots\cdots\cdots\end{matrix}\mathrm{Y} + \begin{matrix}\cdots\cdots\cdots\\ \cdots\cdots\cdots\end{matrix}\beta$$

(3)

(ii) Use the table to identify element Y.

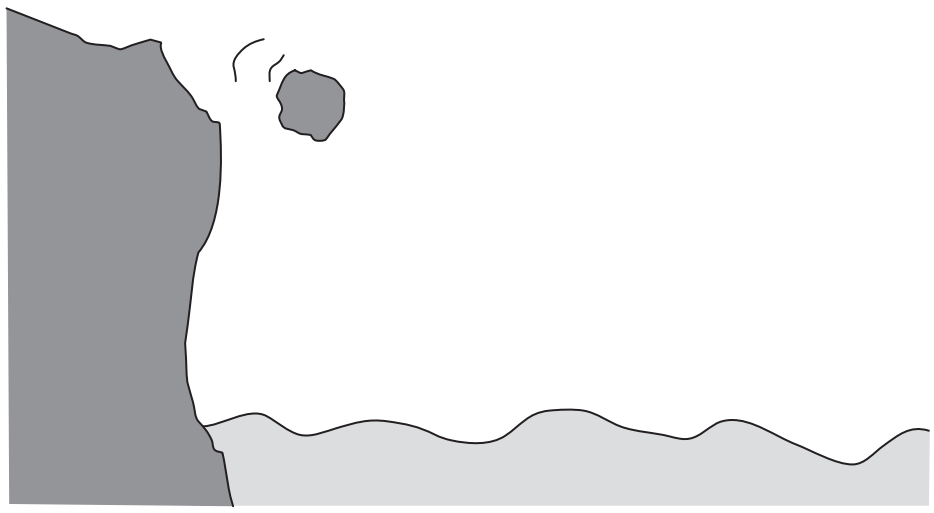
.....

(1) **Q12**

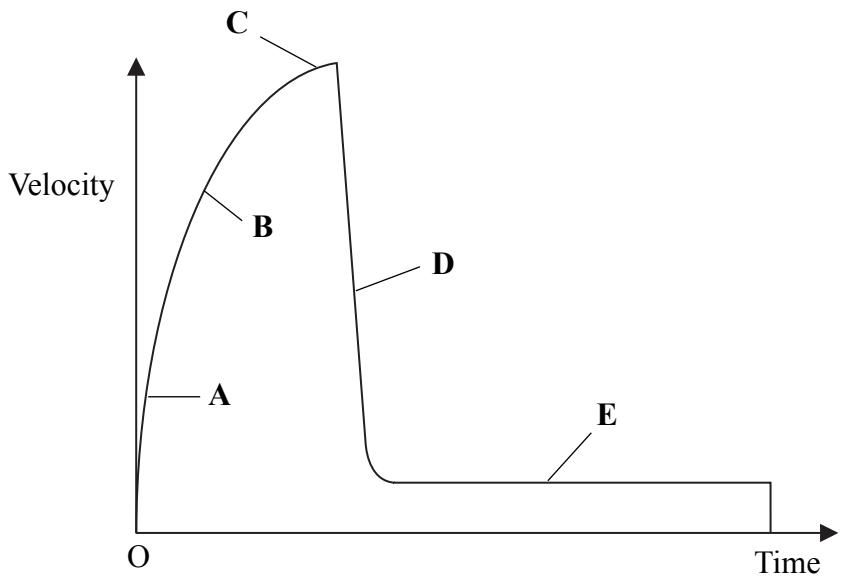
(Total 7 marks)

Leave blank

13. During a storm, a large rock falls from a high cliff into the sea.



The graph shows the velocity of the rock as it falls from the cliff until it reaches the bottom of the sea. **A**, **B** and **C** are stages in its fall before it hits the sea.



(a) State the property of the graph that can be used to determine

(i) acceleration,

.....

(1)

(ii) distance travelled.

.....

(1)

Leave blank

(b) (i) Does the rock reach terminal velocity in air?

.....

(1)

(ii) Explain your answer.

.....

.....

(1)

(c) **A**, **B**, **C**, **D** and **E** represent stages in the fall of the rock.
At which of these stages does the rock have

(i) greatest acceleration, ...

(1)

(ii) greatest deceleration, ...

(1)

(iii) the greatest force acting on it due to air resistance? .....

(1)

(d) Describe and explain the motion of the rock when it is in the sea at stage **E**. Use the concepts of drag, weight, acceleration and velocity in your answer.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(4)

Leave blank

(e) Explain how the graph shows that the height of the cliff is greater than the depth of the sea.

.....

.....

(2)

Q13

(Total 13 marks)

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14. (a) Complete the sentence.

A scalar quantity has size but a vector quantity has both size and

.....

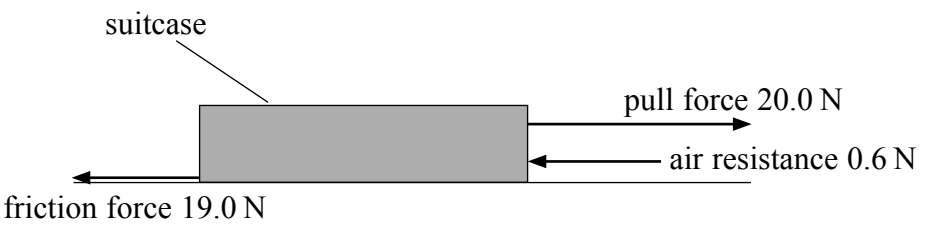
(1)

(b) Identify the quantities in the table as either scalar (**S**) or vector (**V**). The first two have been done for you.

Quantity	Type
speed	S
force	V
displacement	
density	
energy	
acceleration	

(2)

(c) A student going to university pulls a large suitcase along the ground. The diagram shows three forces acting on the suitcase.



Calculate the unbalanced force in newtons and state its direction.

Unbalanced force = ... N

Direction .....

(2)

Q14

(Total 5 marks)

Leave blank

15. (a) Use words from the box to complete the sentences about sound waves in air.

amplitude	**frequency**	**gap**	**period**	**speed**	**wavelength**

The pitch of a sound can be reduced by reducing its .....

The loudness of a sound can be reduced by reducing its .....

The ..... of a sound wave in air depends on temperature.

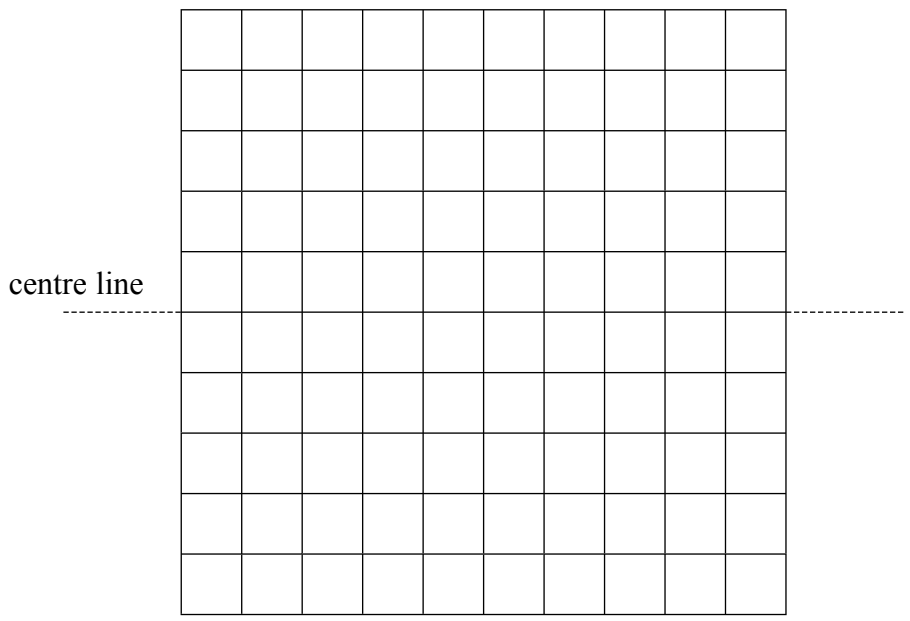
(3)

(b) Name **one** piece of apparatus, other than an oscilloscope, that is needed to display a sound wave on an oscilloscope screen.

.....

(1)

(c) The diagram shows the grid on an oscilloscope screen.



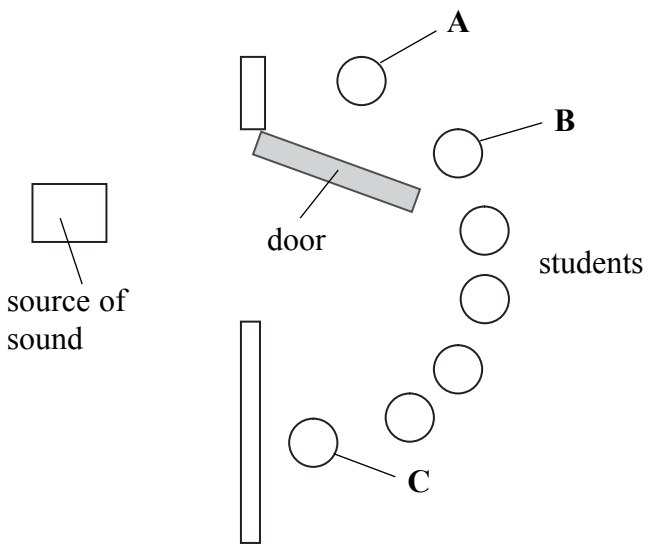
The settings are 10 ms/div and 2 V/div.

Draw on the grid the display for a wave of frequency 25 Hz and amplitude 4 V.

(3)

Leave blank

(d) A teacher sets up a source of sound waves behind a closed door. The sound waves have a wavelength of one metre. Students on the other side of the door cannot hear the sound.
When the door is opened only student **A** cannot hear the sound.



Explain why students **B** and **C** can hear the sound.

.....

.....

.....

.....

(3) **Q15**

(Total 10 marks)

TOTAL FOR PAPER: 120 MARKS

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